AUSTRALIANS TOGETHER

TEACHER GUIDE
Y7 SCIENCE

Forces and motion

Warning – First Nations teachers and students are advised that this curriculum resource may contain images, voices or names of deceased people.

Forces and motion

Essential Question
How do First Nations Peoples use unbalanced forces to enhance motion in the design of everyday objects?

Australian Curriculum Link
Science/Year 7/Science Understanding/Physical sciences/ACSSU117

Science/Year 7/Science as a Human Endeavour/Nature and development of science/ACSHE223

Science/Year 7/Science Inquiry Skills/Processing and analysing data and information/ACSIS130

Science/Year 7/Science Inquiry Skills/Evaluating/ACSIS131

Science/Year 7/Science Inquiry Skills/Communicating/ACSIS133

Australian Curriculum Content Description
ACSSU117: Change to an object's motion is caused by unbalanced forces, including Earth's gravitational attraction, acting on the object.

ACSHE223: Science knowledge can develop through collaboration across the disciplines of science and the contributions of people from a range of cultures.

ACSIS130: Summarise data, from students' own investigations and secondary sources, and use scientific understanding to identify relationships and draw conclusions based on evidence.

ACSIS131: Reflect on scientific investigations including evaluating the quality of the data collected, and identifying improvements.

ACSIS133: Communicate ideas, findings and evidence-based solutions to problems using scientific language, and representations, using digital technologies as appropriate.

Australian Curriculum Elaboration
ACSSU117: Investigating the effect of forces through the application of simple machines, such as the bow and arrows used by Torres Strait Islander Peoples or the spear throwers used by Aboriginal Peoples.

ACSIS130: Referring to relevant evidence when presenting conclusions drawn from an investigation.

ACSIS131: Suggesting improvements to inquiry methods based on experience.

ACSIS133: Presenting the outcomes of research using effective forms of representation of data or ideas and scientific language that is appropriate for the target audience.

ACSIS133: Using digital technologies to access information and to communicate and collaborate with others on and off site.

Australians Together Learning Framework

Our resources follow a framework of 5 Key Ideas that are designed to shape a new narrative for all people who call Australia home. Each Key Idea underpins the content and activities in its section to take students on a transformational learning journey. You can download the framework from our Curriculum Resources page.

The Wound

Injustice from the impact of colonisation

Students will recognise the pain and disadvantage many First Nations people experience, that started at colonisation and continues today.

Our History

A past that shapes our story as a nation

Students will critically engage with Australia's stories and understand the impact our history continues to have on First Nations people and all who call Australia home.

Why Me?

What's it got to do with me?

Students will explore why First Nations histories and cultures are relevant to them today.

Our Cultures

Everyone has culture. Know about your culture and value the cultures of others

Students will learn more about their own culture and identity, and gain a better understanding of, and respect for, First Nations cultures.

My Response

Steps we can take to build a brighter future

Students will gain an understanding that a brighter future is possible for all people who call Australia home, but to get there we each need to play our part.

Glossary

Terms that may need to be introduced to students prior to teaching the resource:

airfoil: a streamlined surface that is designed to help in lifting or controlling an aircraft by allowing air to flow around it.

air resistance: the force of air pushing against other objects as they move past each other, also known as drag.

angular momentum: the speed of rotation of something around an axis, otherwise known as spin.

Aristotle: one of the most well-known and influential Greek philosophers from the fourth century BCE (born 384 BCE). His works and ideas shaped centuries of philosophical thought.

Country: a place that First Nations Peoples belong to as well as a belief system. It is a relationship with all living things that are part of a landscape and includes everything within that landscape; rocks, trees, creeks, animals, plants, medicines, sacred sites, songs, stories, dance and art, as well as all people, ancestral spirits and community connections: past, present and future. Country sustains First Nations Peoples and must be cared for and respected by and for every generation that is and will be. (English term)

First Nations Peoples: Aboriginal and/or Torres Strait Islander Peoples.

forces: influences that can change the motion of an object, either through a push or a pull.

Gweagal: Traditional Custodians of the southern lands of Sydney, New South Wales (also Gwiyagal).

Isaac Newton: an English mathematician and physicist from the 17th century (born 1643). One of the most influential scientists of all time.

lift: the sum of all the forces on a body that force it to move perpendicular to the direction of flow.

mass: the amount of matter in an object. It differs to weight, as weight is a measure of how the force of gravity acts upon the mass of an object.

mechanics: the branch of physics that describes motion and explains why motion occurs.

Namba Gumbaynggar: Traditional Custodians of the lands that span the mid-north coast of New South Wales.

Ngarrindjeri: Traditional Custodians of the lands that span the Lower Murray, Coorong and Lakes regions of South Australia.

physics: the scientific study of matter and energy and how they interact.

Western: a term used to describe things, people, ideas or ways of life that come from or are associated with the countries of Western, Northern, and Southern Europe, as well as the United States, Canada, United Kingdom, Australia and New Zealand.

Wiradjuri: Traditional Custodians of the lands in central New South Wales.

	Teacher guidance	Ideas for student activities
Introduction	*Before beginning the study, ask students to access their prior knowledge about the topic with an introductory question or activity* **Inquiry question** Why do things move? **Resource overview** Students explore how First Nations Peoples use unbalanced forces to enhance motion in the design of tools. They're given opportunities to understand the physics of motion through a variety of hands-on science activities that are underpinned by First Nations pedagogy. *Note:* This resource focusses on the ways knowledges of forces and motion are used by First Nations Peoples in the design and creation of tools, which we have chosen to focus on in place of the example elaborations provided by ACARA. **Pedagogical approach** Where possible, consider using the 8 Ways pedagogical framework in your teaching. As explained in its fact sheet, 'Teaching through Aboriginal processes and protocols, not just Aboriginal content validates and teaches through Aboriginal culture and may enhance the learning for all students' (8 Ways 2012, p. 1). This resource has incorporated (and noted where applied) the following ways of First Nations learning as guided by the pedagogy: • Community links: where possible, collaborating with the local community to apply learning for the benefit of that community. • Land links: place-based learning, linking the content to local land and place. • Learning maps: explicitly mapping or visualising processes. • Non-verbal: applying intra-personal and kinaesthetic skills to thinking and learning.	**Why do things move?** **Observing movement** As a class, find a quiet place in your school grounds to sit outside in a circle. Silently observe your surroundings for one minute. Is anything moving? What objects remain still? **Pondering movement** Consider: 'Why are some objects moving while other objects remain still?' (*see* 8 Ways: non-verbal, land links). **What makes things move?** **Yarning circle** As a class, take turns to discuss your ideas about why objects move. If you're sitting on the ground, you may like to express your ideas by doing drawings in the dirt to help visualise your thoughts (see 8 Ways: learning maps). *Teacher's note:* You may wish for students to write down their individual thoughts as a diagnostic tool to see how their understanding changes as a result of this learning.

Teacher guidance

- Story sharing: approaching learning through narrative.
- Deconstruct/Reconstruct: modelling and scaffolding, working from wholes to parts (watch then do).

Student handout content

Why do things move?

We live in a world of movement. If you sit outside for a few minutes and just observe your surroundings, you'll notice there's a lot of movement. From leaves blowing in the wind, ants crawling along the ground, to clouds floating across the sky. Objects are in motion everywhere.

Figure 1: Ants moving in a group

Source: Elizaveta Galitckaia/Shutterstock.com

Figure 2: Clouds moving across the sky

Source: Kay Cee Lens and Footages/Shutterstock.com

However, many things don't move. Have you ever wondered why some objects move, while others remain still? The study of motion in science is called **mechanics** and falls under the branch of **physics**.

Useful resources

To find out about the 8 Ways pedagogical framework, look at the:

- 8 Ways website: https://www.8ways.online
- *8 Aboriginal Ways of Learning fact sheet* (2-minute read): https://www.painaustralia.org.au/static/uploads/files/8-aboriginal-ways-of-learning-factsheet2-wfklwmnralub.pdf

This information from the Queensland Curriculum and Assessment Authority explains how to conduct a yarning circle (3-minute read): https://www.qcaa.qld.edu.au/about/k-12-policies/aboriginal-torres-strait-islander-perspectives/resources/yarning-circles

Our Cultures

Teacher guidance

Help students connect with and acknowledge the importance of culture and examine the living cultures of First Nations Peoples, which have adapted and survived since colonisation.

In this section, students explore the historical context of the Western ideas that underpin the curriculum relating to classical mechanics in physics. Students then apply this knowledge to First Nations technology, in particular the boomerang. There are multiple prompts to allow students to consider the cultural aspects of boomerangs alongside their understanding of the physics of how boomerangs move. This encourages students to value and respect First Nations Peoples through an understanding of the importance of culture.

Western ideas on motion

For the experiment in this section students will need access to a glass of water and postcard sized piece of cardboard. The experiment could be done individually or in pairs/small groups depending on equipment availiable.

Student handout content

Western ideas on motion

Greek philosophers were among the first Westerners to have written about their ideas on how and why things move. For instance, **Aristotle** believed that heavier objects fell faster than lighter ones. This idea seems to make sense because objects with more **mass** will have a larger gravitational force, which you might think would pull them to the ground quicker. But, if you remove the effect of **air resistance**, you'll find that all objects fall at the same rate (Allain 2013).

Figure 3: Aristotle

Source: Marusya Chaika/ Shutterstock.com

It wasn't until 1687, about 2,000 years after the time of ancient Greek philosophy, **Isaac Newton** wrote about **forces** as being the cause of motion in our universe. His three laws of motion, explained in his work *Principia Mathematica,* form the scientific basis for understanding motion today (Britannica 2020).

Figure 4: Isaac Newton

Source: Marusya Chaika/ Shutterstock.com

Ideas for student activities

Western ideas on motion

Read

Read the student handout section '**Western** ideas on motion'.

Watch

Watch the video, *Brian Cox Visits the World's Biggest Vacuum* (04:41), which shows Professor Brian Cox performing an experiment inside the world's biggest vacuum to see whether a bowling ball and a bunch of feathers will fall at the same rate.

Air pressure experiment

Observe what happens when your teacher demonstrates the upside-down glass of water trick, as shown in the video, *Upside Down Glass of Water Trick – Science Experiment* (00:45).

As a class, discuss what you know about air pressure, using the following questions as prompts:

- Why does the water stay inside the glass, instead of falling out as you'd expect?
- Can you explain the result of this experiment in terms of the unbalanced forces acting on the water?
- How does this relate to the video you watched of the experiment showing the falling bowling ball and feathers?

Now try the experiment for yourself. Did performing this experiment yourself bring up any further questions you have about what's happening? Are there any variations to this experiment you'd like to try? (*see* 8 Ways: deconstruct/reconstruct)

Teacher guidance

Forces

You know from experience, that in order to make a still object move, you need to push or pull it. A force is simply a push or a pull on something.

Forces can be categorised into two broad groups: *contact forces* and *non-contact forces* (see Figure 5):

- *Contact forces* include any push or pull between objects that physically touch, like the applied force of your hand when you push a toy car along the ground, or the frictional force of the surface of the ground as it pulls the car to a stop.
- *Non-contact forces* are those that can attract or repel an object from a distance, like the force of gravity pulling objects towards each other, or magnetic or electrical forces.

Newton proposed that any change to an object's motion is caused by unbalanced forces acting on that object. For example, objects fall to the ground because the gravitational force (weight) is far greater than the air resistance force (drag) acting against it (see Figure 6).

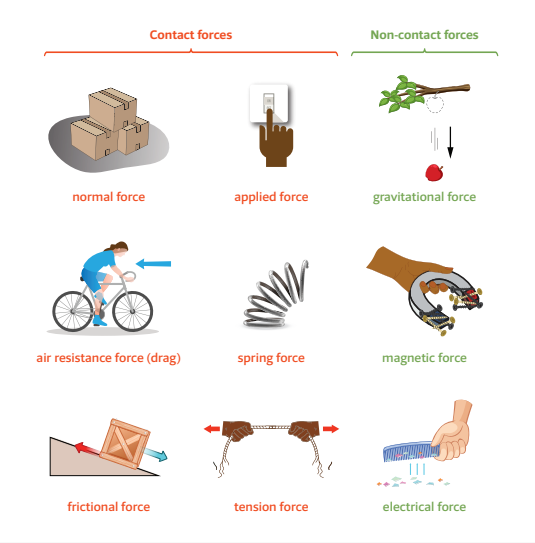


Figure 5: Types of forces

Source: udaix/Shutterstock.com

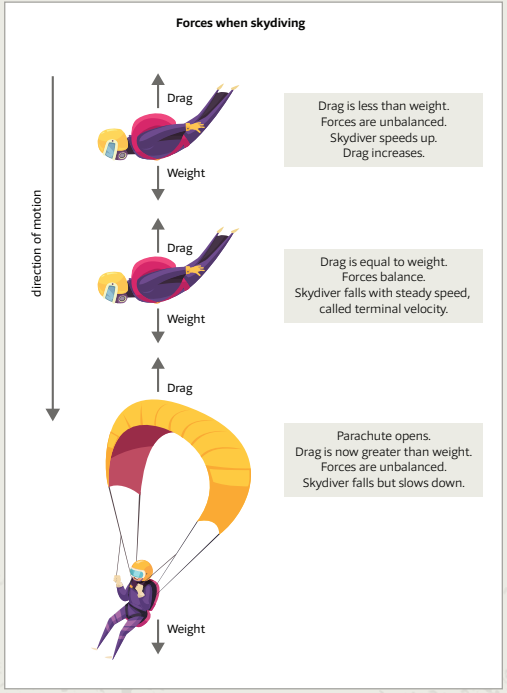


Figure 6: Forces when skydiving

Source: Macrovector/Shutterstock.com

Ideas for student activities

Understanding boomerangs

Read

Read the student handout section 'First Nations understanding of motion'.

Watch

Watch the video *How does a Boomerang Work?* (00:00–01:33) to understand the physics behind how a returning boomerang works.

To help gain a cultural perspective and understanding of the boomerang, now watch the video *Wiradjuri Echos* (02:58). This clip shows Duncan Smith, a **Wiradjuri** man, telling a Dreaming story about how the boomerang came to be according to Wiradjuri People. (*see* 8 Ways: story sharing)

Research local designs

Using the AIATSIS 'Map of Indigenous Australia', find the First Nations **Country** your school is located on.

Research the specific tools and weapons (i.e. simple machines) used by local First Nations Peoples from your area. (see 8 Ways: land links)

If possible, get in touch with local First Nations representatives in your area to learn about the local boomerang styles and designs specific to that Country. Make sure the person is remunerated for their time. Find out whether boomerangs of different designs had different purposes. Note that not all First Nations Peoples used boomerangs, so you may not be able to use a local example. (*see* 8 Ways: community links)

If that's not possible, contact local and state museums for information. They may have virtual tours of their collections, or you could visit in person.

Teacher guidance

First Nations understanding of motion

The knowledges of **First Nations Peoples** reflect a deep understanding of forces and motion in many different ways, including knowledge of celestial cycles and patterns (see Australians Together curriculum resource 'Y7 Science – The cycles of Earth and space'), but also through the careful engineering of tools, weapons and toys, in particular, the boomerang.

Boomerangs

A boomerang is a multi-purpose tool with a wide variety of styles made by different First Nations Peoples (see Figure 7). They're often touted for their ability to return to the thrower, but the vast majority of boomerangs are designed not to return (NMA 2022). Many of these boomerangs are used for hunting and are intended to hit an animal with enough force to take it down. Think about the reasons why you might want a boomerang to return to you – what might be the purpose/s of a returning boomerang?

Figure 7: The different styles and designs of boomerangs on display at the South Australian Museum

Source: South Australian Museum (n.d.) *Boomerang display at the South Australian Museum* [photograph], © South Australian Museum website. Reproduced with permission.

With more than 250 different First Nations languages spoken today across this vast continent, it makes sense that boomerang designs also vary widely. Their shape and size depend on what they're being used for in the context of the local environmental conditions. For instance, larger and heavier boomerangs are generally used by First Nations people who live inland or in the desert, whereas lighter boomerangs are usually thrown by First Nations people living in coastal and high-country areas (NMA 2022). Why might this be the case?

Discuss as a class.

Ideas for student activities

Boomerang design experiment

The aim of this investigation is to compare and contrast the flying abilities of two different boomerang designs to ultimately decide which design you think's the best.

Choose a design

Read through the information on the wikihow.com webpage *How to Make a Boomerang* (7-minute read) and choose one of the three designs to create for yourself.

Gather the materials and follow the instructions to create your boomerang at home.

Test

Bring your boomerang to school and take turns to test out its flying abilities with your class on your school oval or in a games area.

Find one of your peers that chose a different boomerang design and take turns to test the flight of each other's boomerang, recording notes of your observations in your science book as you go. These observations will be the data for your results, so make sure you think carefully about how you're going to represent this data when you write your report. Here are some questions you might like to consider:

- How might you assess the flying performance of each boomerang for your results? (e.g. Did it return to its thrower? How far did it travel?)
- How many throws will you need to conduct to adequately assess the flying performance of each design?
- Is the boomerang being thrown in the same way by the same person each time? Why should this matter?

Teacher guidance

Teacher's note: You might like to lead a class discussion after students read this paragraph to allow them to share their ideas. The design of any boomerang is largely dictated by two factors: the animal being hunted; and the trees available to make the boomerangs. These factors also dictate the shape, size and usage of the boomerangs. Larger and heavier boomerangs are used to target and kill large animals, whereas smaller and lighter boomerangs could be used to startle and rustle smaller animals out of bushes and trees. It's also worth noting that some boomerangs are purely ceremonial and some are used as musical instruments.

Design details

Boomerangs that are designed to fly through the air have a distinctive **airfoil** design like that of an aeroplane wing (see Figure 8). This design allows the air moving past the bottom of the airfoil to move faster than the air over the top, creating a higher air pressure below, which creates **lift**.

If you study the shape of the airfoil on each arm of a boomerang, you'll notice that they're reversed (see Figure 9). This makes sense when you understand that the boomerang is thrown with spin, or **angular momentum**.

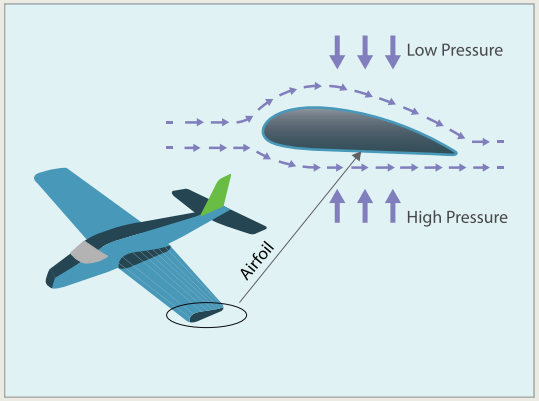


Figure 8: Shape of the airfoil design on a plane wing

Source: fridas/Shutterstock.com

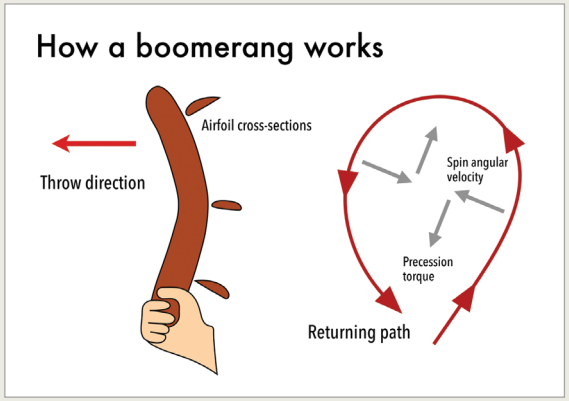


Figure 9: How a boomerang works

Source: Dimitrios Karamitros/Shutterstock.com

Boomerang designs have been perfected over many thousands of years. The oldest images of boomerangs are about 20,000 years old, found among the Gwion Gwion rock art paintings in the Kimberley (NMA 2022). Although the overall design of each specific type of boomerang has evolved over time, it's important to note that each individual handmade boomerang has been uniquely engineered to perfection.

Ideas for student activities

Report

Write a scientific report of your findings using the following headings:

- Aim
- Materials
- Method (include diagrams of both designs)
- Results
- Discussion
- Conclusion.

In particular, evaluate the quality of the data you've collected and think carefully about the limitations of your experiment. Were you able to decide which design you thought was better? Why did you decide this? What would you do differently if you were to re-do this investigation?

Extension activity

What improvements could you make to the design of your boomerang? If you have time, reshape or remake your design to see if you can make improvements to its flight and then test it out!

Teacher guidance

Senior **Gweagal** knowledge holder, Shayne Williams, explains the process:

> So people would, you know, be patient, they would take the boomerang knee or elbow from the tree, get the shape they want, dry it out in the shade, and then, you know, they could sit there for a few weeks or so before it's dried properly, and then they would actually use bits of glass and spend days and days just scraping it back, till you've got this really smooth shape here on the face of it, and on the back as well.
>
> And people didn't rush either, they took their time, you know, they had pride in what they was doing and they wasn't in a great hurry. And because this was all done by hand, you'll always get each item quite different to the next one, because they're not mass produced like from factories … they've been done by hand, actually unique. And I think that is what probably makes these things special … (NMA 2022, paras 19–20).

Useful resources

Western ideas on motion

The video, *Brian Cox Visits the World's Biggest Vacuum*, shows Professor Brian Cox performing an experiment inside the world's biggest vacuum to see whether a bowling ball and feathers will fall at the same rate (04:41): https://www.youtube.com/watch?v=E43-CfukEgs

The WIRED article 'Do heavier objects really fall faster?' contains great detail and considerations on this question, written in an easy-to-understand manner that may be useful for teachers without a physics background (14-minute read): https://www.wired.com/2013/10/do-heavier-objects-really-fall-faster/

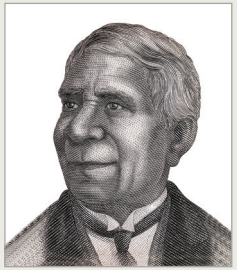
Air pressure experiment

Counter-intuitive demonstrations are very powerful and memorable, so the demonstration in the video, *Upside Down Glass of Water Trick – Science Experiment* is a great way to get students to think about air pressure as a force that's being constantly applied to them and everything around them (00:45): https://www.youtube.com/watch?v=65T4ReLkjCg

Some particularly inquisitive students might wonder what would happen if you used different liquids instead of water in the glass. You might like to turn this into a larger experiment to show that it's not simply air pressure that keeps the water upside down in the glass, but also the properties of water itself in being a particularly 'sticky' molecule. If you don't have time to experiment, the video, *Levitating Water Experiment,* will make this point (09:38): https://www.youtube.com/watch?v=_iWHNqJggnk

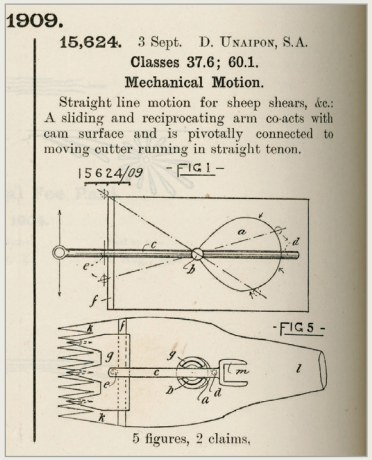
Investigating boomerangs

The Veritasium YouTube video, *How does a Boomerang Work?*, explains the physics of how a returning boomerang works (02:52): https://www.youtube.com/watch?v=ADJKsLEAOHo

	Teacher guidance	Ideas for student activities
	The video, *Wiradjuri Echos*, shows Duncan Smith telling a Dreaming story, How the Boomerang Came to Be, about how the returning boomerang came to be a part of Wiradjuri Peoples' culture (02:58): https://www.youtube.com/watch?v=r6q4V74zpxI The wikiHow article, *How to Make a Boomerang*, explains three different step-by-step ways to make a homemade boomerang, suitable for students to make at home or in the classroom (7-minute read): https://www.wikihow.com/Make-a-Boomerang The AIATSIS 'Map of Indigenous Australia' shows the general locations of larger groupings of First Nations Peoples across the continent. It can be a valuable addition to the classroom wall as a visual prompt for students to recognise the diversity of First Nations cultures: https://aiatsis.gov.au/explore/map-indigenous-australia The National Museum of Australia (NMA) website has a range of articles relating to the boomerang and is a good place for students to start doing some research: https://www.nma.gov.au/exhibitions/defining-symbols-australia/boomerang	
Our History	*There are many stories that make up Australia's history. It's important to use resources that include perspectives and voices of First Nations people, such as those contained in this resource.* This section highlights and celebrates the achievements of Ngarrindjeri man, David Unaipon, as part of our shared history. It allows students to acknowledge how our shared past continues to have an impact on our present context – in this case, the positive effects of scientific discovery and invention. **Student handout content** **A famous inventor** **David Unaipon** The boomerang served as inspiration for one of the concepts of the famous inventor and **Ngarrindjeri** man David Unaipon (1872–1967), whose image is printed on the Australian $50 bank note (see Figure 10). Unaipon was a prolific inventor who, among other things, used his knowledge of forces and the motion of boomerangs to come up with the design concept for helicopter flight, as recorded in this *Daily Telegraph* article: > David Unaipon … is now at work on an invention to enable aeroplanes to rise vertically from the ground … it occurred to him that the principle underlying the flight of the boomerang might be applied to the aeroplane to do away with the preliminary run. He says that he thinks he has solved the problem. He is having constructed appliances to allow him to make conclusive trials (Australian Aborigines Mission 1914, p. 7).  **Figure 10**: Drawing of David Unaipon as it appears on the Australian $50 bank note Source: Prachaya Roekdeethaweesab/ Shutterstock.com	**A famous inventor** **Read** Read the student handout section 'A famous inventor'. **Research** Broadly research the life and works of David Unaipon, drawing upon information from at least five different sources. Choose one of Unaipon's inventions to learn about focusing on the forces that determine the motion of the invention (e.g. mechanical sheep shears). **Summarise and present your research** Summarise your research in one of two ways: • a poster with writing and drawings that explain the physics behind your chosen Unaipon invention

Teacher guidance

Unaipon is most famous for inventing the mechanical sheep shears that shearers still use today (see Figure 11 for his provisional patent drawings). Before his invention, shearers were using metal hand shears (see Figure 12), causing a great deal of strain on the shearer's hand and taking far more time than the mechanical shears. His invention revolutionised the wool industry by saving time and money, and resulted in fewer workplace injuries.



1909.

15,624. 3 Sept. D. Unaipon, S.A.

Classes 37.6; 60.1.

Mechanical Motion.

Straight line motion for sheep shears, &c.: A sliding and reciprocating arm co-acts with cam surface and is pivotally connected to moving cutter running in straight tenon.

15624/09 - FIG 1 -

- FIG 5 -

5 figures, 2 claims.

Figure 11: David Unaipon's patent specification for his mechanical sheep shears invention

Source: Australia Patent Office (1910) *Patent specification. Mechanical motion. Sheep shears* [drawing], State Library of South Australia website. Reproduced with permission.

Figure 12: Old method of shearing sheep with metal hand shears

Source: Dalibor Sevaljevic/Shutterstock.com

Useful resources

David Unaipon

Kamilaroi man Corey Tutt's book *The First Scientists: deadly inventions and innovations from Australia's First Peoples* has information about David Unaipon that could be used as research material for students: https://www.hardiegrant.com/au/publishing/bookfinder/book/the-first-scientists-by-corey-tutt/9781741177527

The video *David Unaipon: Australia's Da Vinci*, produced by the Woolmark Company, highlights one of David Unaipon's inventions (the first straight-line motion shearing machine) that's had a profound impact on the wool industry (09:07): https://www.youtube.com/watch?v=xV4hgI_sl9Y

Ideas for student activities

- a video with you verbally explaining the physics behind your chosen Unaipon invention, with the help of visual aids (either drawn by hand or using computer animation).

Make sure your presentation clearly explains how Unaipon's invention moves and what forces are at play when the invention is at rest and in motion.

The Wound

Teacher guidance

The story of our nation's past is hard to face but it's important; it's left a wound that can be seen in the inequality between First Nations people and non-Indigenous Australians. Help students understand how this wound continues to have an impact today.

This section explains some of the injustice David Unaipon experienced as a case study for students to empathise with First Nations people and understand why many still experience injustice and disadvantage.

Student handout content

Historical injustice

David Unaipon – exploited and disregarded

Although David Unaipon is now celebrated as the great thinker, writer and inventor that he was, this wasn't always the case. He experienced many injustices that were common to First Nations people in Australia in the early 20th century.

For instance, in the 1920s David Unaipon would have been the first Ngarrindjeri person to publish a book, if his research and writing hadn't been blatantly stolen by William Ramsay Smith, the Chief Medical Officer of South Australia (ABC 2002). Unaipon was commissioned by the University of Adelaide to collect First Nations stories from across South Australia. His collection of stories was published in the book 'Myths and Legends of the Australian Aboriginals' under the name William Ramsay Smith, without acknowledgement that he was the author (MUP n.d.).

Figure 13: William Ramsay Smith

Source: Pascoe JJ (1901), *William Ramsay Smith* [photograph], National Library of Australia website. Reproduced with permission.

Unaipon also found it difficult to raise the funds needed to patent many of his inventions, leaving many of his ideas and hard work open to plagiarism (AIATSIS n.d.).

Overall, David Unaipon was treated as an anomaly (someone who doesn't behave as expected). It was simply unimaginable to most non-Indigenous people at the time that a First Nations person could achieve the scientific knowledge and understanding that Unaipon did, and apply this to create new and novel inventions.

Useful resources

The *Daily Herald* article, 'An Aboriginal genius', written in 1914 about the work of David Unaipon, can be accessed via TROVE (9-minute read): https://trove.nla.gov.au/newspaper/article/125060204

The 'Think, Pair, Share' visible learning routine by Project Zero at Harvard University is explained in the resource link of their webpage (2-minute read): http://www.pz.harvard.edu/resources/think-pair-share

Ideas for student activities

Historical injustice

Read

Read the student handout section 'Historical injustice'.

Next, read the article 'An Aboriginal genius' (9-minute read) from the *Daily Herald* (1914), making note of any passage, sentence or statement that contains racism.

Think, Pair, Share

Complete the following steps in this Think, Pair, Share activity:

- Think about how the reading activity above made you feel and whether it's made you think differently about how First Nations people have been treated historically.
- Pair with a nearby student.
- Share your thoughts with your partner, taking turns to listen and ask questions.

	Teacher guidance	Ideas for student activities
Why Me?	*Help students understand that because they call Australia home this relates to them. Explore what's happening, or has happened, around your local area that's relevant to this topic.* These activities allow students to appreciate the interconnectedness of their learning with attitudes and behaviours towards First Nations Peoples and cultures. **Student handout content** **What have you learnt so far?** Reflect on all you've learnt so far about forces and motion. You may never before have connected physics, or even science as a whole, to First Nations histories and cultures. How do you think connecting the two might benefit you and the broader community? **What can you do with your new knowledge?** Think about which parts of this learning have really interested you. What else might you like to know? How will you find out? Think about what you can do to meaningfully respond to the ideas and concepts you were exposed to throughout this learning. Some ideas are listed below. You could: • complete some further research on First Nations technologies that relate to mechanics: the physics of motion. For example, a *wommera* (spear-thrower), is a type of lever that allows a spear to be thrown much further than it would go just by hand • consider learning more about the local First Nations language/s in your area • put up the AIATSIS map in your classroom • share what you've learnt with your family and allow them to share their knowledge with you. **Useful resources** *Wiruungga with Bullroarer* features Wiruungga Dunggiirr, Namba Gumbaynggar Elder, demonstrating how to make a sound using a bullroarer (00:52): https://www.youtube.com/watch?v=YSSgdgbp1FM Find the 'Connect, Extend, Challenge' visible learning routine by Project Zero at Harvard University here (2-minute read): http://www.pz.harvard.edu/sites/default/files/Connect Extend Challenge_1.pdf This Australians Together article, 'What does this have to do with me?' explains many viewpoints on why learning about First Nations histories, cultures and perspectives is important. It may be useful for students (10-minute read): https://australianstogether.org.au/discover/my-part/why-me/	**What have you learnt so far?** **Read** Read the student handout section 'What have you learnt so far?' **Discuss** As a class, discuss why you think it might be important to connect First Nations histories and cultures across the Australian Curriculum. **Watch** Watch the video, *Wiruungga with Bullroarer* (00:52) featuring Wiruungga Dunggiirr, **Namba Gumbaynggar** Elder, demonstrating how to use a bullroarer. **Connect, Extend, Challenge** Consider what you've just watched and then write answers to the following questions in your science books: • How's the content of the video connected to what you already know about forces, motion and First Nations histories and cultures? • What new ideas did you have that broadened or extended your thinking? • What challenges or puzzles emerge for you?

My Response

Teacher guidance

Help students critically and creatively process and demonstrate their learning on this topic by exploring meaningful ways to respond. Ask students to come up with their own ideas about what they can do.

This final section enables students to understand that respectful relationships and connections with First Nations Peoples helps to reduce the injustices and disadvantage they experience. The ultimate goal is for students to actively respond in respectful and meaningful ways to First Nations Peoples in both their personal and professional lives.

Student handout content

ASSESSMENT TASK

Y7 SCIENCE

Forces, motion and First Nations toys

Essential question

How do First Nations Peoples use unbalanced forces to enhance motion in the design of everyday objects?

In this assessment task, you'll choose a First Nations toy to research, recreate and investigate to demonstrate your understanding of the essential question.

Research a First Nations toy

Choose a First Nations toy to research from the categories listed below:

- Rattles
- Spinning tops
- Balls
- Weet weets
- Toy bows and arrows
- Toy propellers
- Toy spears and targets.

(*Note*: the links above direct you to the 'Aboriginal toys' section of the Australian Museum website.)

You're going to create a poster presentation to summarise your research findings. On your poster you'll need to do the following:

- Describe your toy. Include what it's made from, how it's used, how it moves and which First Nations People/s the toy is made by.
- Draw a force diagram of your toy, showing all the forces acting upon the toy when it's both at rest and in motion.

Ideas for student activities

Assessment task

Forces, motion and First Nations toys

Complete the assessment task, 'Forces, motion and First Nations toys', on page 9 of your student handout.

What can you do now?

Read

Read the student handout section 'What can you do with your new knowledge?'

Call to action

What's your call to action? You're more likely to perform an action if you write it down and plan to do it by a particular date. In your science book, complete the gaps in the sentence below:

'My call to action is to _____ and I will do this by the date ____/____/____.'

Teacher guidance

Make a prototype

Make a prototype recreation of your toy as closely as you can to the original, trying to use the same materials and methods used by First Nations people.

Demonstrate and present

Present your poster and prototype to the class. Safely demonstrate how your toy is used in motion and explain the design features of your toy that enhance its motion.

Useful resources

The Australian Museum website has information about First Nations toys and is a good place for students to start their research for the assessment task: https://australian.museum/learn/cultures/atsi-collection/aboriginal-toys/

For help with pronunciation of First Nations language groups and locations, the 'Gambay First Languages Map' is a valuable interactive resource: https://gambay.com.au/

First Languages Australia has many links to language projects and websites that may be of interest: https://www.firstlanguages.org.au/

	Teacher guidance
References	8 Ways (n.d.) 8 Aboriginal Ways of Learning, 8 Ways website, accessed 12 February 2022. ABC (Australian Broadcasting Corporation) (2002) 'David Unaipon – in his own words', ABC News website, accessed 1 March 2022. AIATSIS (The Australian Institute of Aboriginal and Torres Strait Islander Studies) (n.d.) *David Ngunaitponi (Unaipon)*, AIATSIS website, accessed 1 March 2022. Allain A (2013) *Do heavier objects really fall faster?*, Wired website, accessed 26 February 2022. Australian Aborigines Mission (31 July 1914) 'An inventive Aboriginal. The aeroplane's rise', (from the Daily Telegraph), *Australian Aborigines' Advocate*, 157, accessed 10 March 2022. Britannica, The Editors of Encyclopaedia (2020) *Force*, Encyclopedia Britannica website, accessed 26 February 2022. MUP (Melbourne University Publishing) (n.d.) 'Legendary Tales of the Australian Aborigines', Melbourne University Publishing website, accessed 14 April 2022. NMA (National Museum of Australia) (2022) *Earliest evidence of the boomerang in Australia*, NMA website, accessed 26 February 2022.
Acknowledgements	8 Ways (n.d.) 8 Aboriginal Ways of Learning, accessed 12 February 2022. Note that *8 Aboriginal Ways of Learning* is referred to throughout this resource with permission. The *8 Aboriginal Ways of Learning: Aboriginal pedagogy* belongs to a place, not a person or organisation. They come from Country in western New South Wales. Baakindji, Ngiyampaa, Yuwaalaraay, Gamilaraay, Wiradjuri, Wangkumarra and other nations own the knowledges this framework come from. **Image sources** Figure 1: *Ants moving in a group*, Elizaveta Galitckaia/Shutterstock.com. Reproduced with permission. Figure 2: *Clouds moving across the sky*, Kay Cee Lens and Footages/Shutterstock.com. Reproduced with permission. Figure 3: *Aristotle*, Marusya Chaika/Shutterstock.com. Reproduced with permission. Figure 4: *Isaac Newton*, Marusya Chaika/Shutterstock.com. Reproduced with permission. Figure 5: *Forces when skydiving*, udaix/Shutterstock.com. Reproduced with permission. Figure 6: *Types of forces*, udaix/Shutterstock.com. Reproduced with permission. Figure 7: South Australian Museum (n.d.), *Boomerang display at the South Australian Museum*, [photograph], © South Australian Museum, accessed 30 March 2022. Reproduced with permission. igure 8: *Shape of the airfoil design on a plane wing*, fridas/Shutterstock.com. Reproduced with permission. Figure 9: *How a boomerang works*, Dimitrios Karamitros/Shutterstock.com. Reproduced with permission. Figure 10: *Drawing of David Unaipon as it appears on the Australian $50 bank note*, Prachaya Roekdeethaweesab/Shutterstock.com. Reproduced with permission. Figure 11: Australia Patent Office (2018), 'Patent specification. Mechanical motion. Sheep shears', *Australian official journal of patents*, 15,624: 910, State Library of South Australia website, accessed 30 March 2022. Reproduced with permission. Figure 12: *Old method of shearing sheep with metal hand shears*, Dalibor Sevaljevic/Shutterstock.com. Reproduced with permission. Figure 13: Pascoe JJ (1901), *History of Adelaide and vicinity: with a general sketch of the province of South Australia and biographies of representative men*, p. 532, published by Hussey and Gillingham, National Library of Australia website, accessed 30 March 2022. Reproduced with permission.

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